English Translation of EP 0661125

Description

The present invention concerns an apparatus for the separation of connecting rods by fracture

- with one stationary expanding jaw,
- with one movable expanding jaw,
- with an expander in the form of an expanding wedge for forcing apart the expanding jaws, and
- with an actuator comprising a hydraulic piston and cylinder unit for applying an expanding force to the expanding wedge.

It is known that the quality of fracture separation results in the separation of connecting rods by fracture depends, amongst other things, on the speed of the separating process. For this reason with a known method and apparatus of another category (cf. DE-U-8 905 863) it has already been proposed to let the fracture separation force act suddenly on the expanding jaws and hence on the connecting rod material in the cross-section of separation. This sudden action is obtained with a known method and apparatus by an impact mass which is accelerated by force of gravity or otherwise and which exerts a direct central impact on a carriage assembly on which is mounted a movable expanding jaw.

Apparatuses equipped with impact masses and carriage assemblies do of course yield outstanding fracture separation results, but are suitable in particular for those fields of application in which there is a possibility of a free arrangement and conditions are not cramped. Thus with a known apparatus of this kind it is for example necessary to support the expanding jaws which are basically held on one side, i.e. cantilevered, in the region of their free ends, that is, in the cramped region, by supporting elements such as clamps and the like, to prevent the expanding jaws from bending.

In practice, therefore, where there are cramped conditions such as exist for example in case of transfer lines or applications with automatic pulsed operation,

apparatuses of the generic kind are used in which the fracture separation force is produced with expanding wedges which force the expanding jaws apart by means of a hydraulic piston and cylinder unit. In apparatuses of this kind, in the cramped region of the big end of the connecting rod must be accommodated only the expanding wedges which are to be arranged well within the expanding jaws, while the parts necessary for operating them such as the hydraulic piston and cylinder unit can easily be arranged outside the cramped regions. Supporting elements such as clamps and the like are not necessary with such constructions on account of the supporting effect of the expanding wedge.

In one apparatus of this kind (cf. for example DE-U-9 210 167) for example the expanding wedge is directly connected to the hydraulic piston and cylinder unit by a push rod for forcing the expanding jaws apart. Thus statically rigid and direct transmission of movement of the piston of the unit to the expanding wedge is ensured, which has a positive effect on the working speed of the apparatus.

It is the object of the invention to develop an apparatus of the kind described hereinbefore and working with an expanding wedge, in such a way that with a technical design as simple as possible a fracture separation process as fast as possible can be carried out.

This object is achieved according to the invention by the fact that the actuator includes an energy storing device as well as a control valve which is arranged between the energy storing device and the piston and cylinder unit and via which hydraulic medium stored under pressure in the energy storing device can be fed suddenly to the piston and cylinder unit.

The invention is based on the concept that, by arranging an energy storing device and a special control valve arranged between the latter and the piston and cylinder unit, the manner of operation of the piston and

cylinder unit can be made so "fast" that a "sudden" action manner of operation which comes close to the category of apparatus operating with impact masses and carriage assembly is obtained and hence a fracture separation result of high quality is achieved by simple technical means. Due to this manner of operation, in the fracture separation process relatively low plastic deformation of the connecting rod material in the region of the fracture plane is ensured, which comes very close to so-called brittle fracture.

Of course with a known method and apparatus for the fracture separation of connecting rods (cf. DE 4 022 860) by means of a piston and cylinder unit referred to as an energy storing device, there is already a fracture separation force applied to a movable expanding jaw over a very short period of time. This energy storing device is however not an energy storing device within the meaning of the present invention, but a piston and cylinder unit in the form of a double diameter piston assembly in which, to perform a fracture separation force, a large-diameter piston section of a first piston is subjected to compressed air and a smaller-diameter piston section of this first piston acts on a hydraulic fluid which in turn acts on a larger-diameter piston face of a second piston which transmits the fracture separation force via a linkage after the fashion of an impact directly to the movable expanding jaw. Known apparatuses of this kind work basically with an impact mass and carriage assemblies and are therefore particularly suitable for fields of application in which there is a possibility of a free arrangement and conditions are not cramped.

Of course the known methods and apparatuses according to DE 4 022 860 also have an expanding wedge which is designed to force the expanding jaws apart. This expanding wedge is however not connected to the double diameter piston assembly described, but serves only via a separate traction device to prestress the

expanding jaws before the actual fracture separation process.

It is advantageous if the energy storing device used is a high-pressure vessel whose interior is divided by a dividing diaphragm into two chambers, one of which is filled with hydraulic medium and the other with a compressed gas. Energy storing devices of this kind are known and have already proved themselves in practice for numerous fields of application. Nitrogen is usually used as the compressed gas.

Basically the control valve can be designed in any fashion. The only essential thing is that the control valve is designed in such a way that within a short period of time, i.e. suddenly, a relatively large throughflow cross-section is available for the hydraulic medium, so that the hydraulic medium stored in the energy storing device can be fed as suddenly as possible to the piston and cylinder unit. It is therefore advantageous if a so-called two-way slip-in valve is used as the control valve. Such valves are frequently also referred to as a cartridge valve in the technical world.

In order to be able to feed the hydraulic medium stored under pressure in the energy storing device as suddenly as possible to the piston and cylinder unit, it is advantageous that both between energy storing device and control valve, and between control valve and piston and cylinder unit, connecting pipes with dimensions as short as possible and low hydraulic resistance are arranged.

For transfer with as little loss as possible of the hydraulic medium fed under pressure to the piston and cylinder unit, it is advantageous if the piston and cylinder unit is fitted with an escape valve with a large control cross-section, so that on the escape side no counterpressure counteracts the hydraulic medium fed in under pressure. It is advantageous in this connection if the control system is designed in such a way that the

escape valve is already open when the pressurised hydraulic medium is fed to the piston and cylinder unit.

Hydraulic circuits operating with pressurised hydraulic medium must be protected against pipe fractures, valve failures or the like to avoid accidents. It is advantageous in this connection amongst other things to provide between the energy storing device and the control valve a safety device with which the energy storing device can be automatically uncoupled from the remainder of the hydraulic circuit in case of need. As minimum equipment it is advantageous to fit such a safety device with a shut-off valve and an overpressure valve.

To achieve high-quality fracture separation results, firstly the expanding jaws must abut against the inner surface of the big end of the connecting rod without play, secondly the parts of the apparatus located in the power transmission chain for the fracture process must be connected to each other without play. For this process, which in the technical world is generally referred to as "prestressing," it is advantageous to provide a prestressing device. This prestressing device can either be integrated in the energy storing circuit or fitted as a separate hydraulic circuit, i.e. be completely independent thereof.

In the case of a prestressing device with a separate hydraulic circuit, it is appropriate to design this in such a way that hydraulic medium can be fed via a separate hydraulic pump directly to the piston and cylinder unit.

Basically the expanding jaws can be arranged in the most varied ways according to the respective structural conditions. A technically advantageous construction is however produced if the stationary expanding jaw is mounted on a stationary apparatus base which also carries the supporting elements for the cap. The movable expanding jaw can in such an arrangement advantageously be arranged on a straight-line mechanism.

Below, for further illustration and for a better understanding two practical examples of the invention are described in more detail and explained with reference to the attached drawings.

Fig. 1 shows schematically in a simplified general view a first embodiment of an apparatus according to the invention,

Fig. 2 shows a partly sectioned view of part of the embodiment shown in Fig. 1 on a larger scale,

Fig. 3 shows schematically a second embodiment of an apparatus according to the invention in a side view,

Fig. 4 shows schematically the embodiment shown in Fig. 3 in a top view, and

Fig. 5 shows schematically a hydraulic circuit such as forms the basis of both the first and second embodiments of the apparatus according to the invention.

The first embodiment of an apparatus 1 according to the invention shown in Fig. 1 is constructed on a lower stand portion 6 such as is used on transfer lines. On the lower stand portion 6 is mounted a frame-like upper stand portion 6a which carries a guide assembly 8 in the form of a vertical straight-line mechanism. On the vertical straight-line mechanism is mounted via guide straps 10 and 11 a movable frame 14 which can be raised or lowered by means of a lifting device 7 fixed to the upper stand portion 6a.

The movable frame 14 in turn carries an expander 5 which carries a stationary expanding jaw 3, i.e. one which is directly attached to the movable frame 14, as well as a movable expanding jaw 4.

The arrangement is such that the stationary and movable expanding jaws of the expander 5 can be lowered from above by means of the lifting device 7 and the movable frame 14 into the big end of a connecting rod 2 arranged in a support on the upper stand portion and consisting of rod and cap, and pulled out of it again.

The precise construction of the expander 5 is apparent from Fig. 2. It can be seen from Fig. 2 that the stationary expanding jaw 3 is attached by fastening bolts 12 to a fastening base 13 of the movable frame 14. The movable expanding jaw 4 again is attached by fastening bolts 12' to a bearing section 21 which is attached by a parallel link assembly 16 by fastening bolts 20 to a holding section 17 which forms part of the movable frame 14. Between the stationary expanding jaw 3 and the movable expanding jaw 4 is arranged an expanding wedge 55 which is connected to a push rod 19 which cooperates with an actuator 9 which will be considered later. The remainder of the construction of the first embodiment of the apparatus according to the invention as shown in Fig. 2 is described in German utility model 9 210 197, whose disclosure content is expressly referred to here.

The actuator 9 for the expanding wedge 55 includes an energy storing device 60 as well as a piston and cylinder unit 61 whose piston is connected to the push rod 19 of the expanding wedge 55.

Between the energy storing device 60 and the piston and cylinder unit 61 are arranged a safety device 62 and a control valve 63. The safety device 62 and the control valve 63 are connected to each other as well as to the energy storing device 60 and the piston and cylinder unit 61 by connecting pipes 64, 65 and 66 with dimensions as short as possible and low hydraulic resistance.

The energy storing device 60 includes a high-pressure vessel whose interior is divided by a dividing diaphragm (not shown) into two chambers, of which the lower chamber is filled with hydraulic medium and the upper chamber with a compressed gas, preferably nitrogen. As already mentioned, energy storing devices 60 of this kind are already known.

The safety device 62 is also a commercially available unit which has a shut-off valve and an overpressure valve.

The control valve 63 again is designed as a so-called two-way cartridge valve with which a relatively large throughflow cross-section can be released within a short period of time, as will be described in connection with the hydraulic circuit according to Fig. 5.

The second embodiment of an apparatus according to the invention shown in Figs. 3 and 4 has basically the same components as have been described in connection with the first embodiment. The arrangement is simply such that the expander 5 is arranged with its components on the upper side of a frame-like mount 70 and the actuator 9 is located within this mount 70 below the working plane for the fracture separation process.

As can be seen in particular from Fig. 3, the stationary expanding jaw 3 is rigidly attached to an apparatus base 71 constructed on the upper side of the mount 70 in the form of a working plate.

The movable expanding jaw 4 again is mounted on a straight-line mechanism 72 which for its part carries a movable mounting for a centring mandrel 28 for the small end of the connecting rod. The straight-line mechanism 72 which allows horizontal movement of the movable expanding jaw 3 is mounted on the apparatus base 71.

In between the stationary expanding jaw 3 and the movable expanding jaw 4 extends from below an expanding wedge 55 which is attached to a push rod 19 which is in turn connected to a piston 62 of a piston and cylinder unit 61 of the actuator 9.

The piston and cylinder unit 61 again is connected by a pipe 64 to a control valve 63 which for its part is connected to a safety device 62 which for its part is arranged at the output of an energy storing device 60.

As can be seen from Figs. 3 and 4, on the apparatus base 71 is also arranged a stop assembly for mounting the connecting rod, which however in the present case will not be considered in more detail.

The hydraulic circuit shown in Fig. 5, on which both the first and second embodiments are based, shows a

connecting rod 2 in the small end of which engages the centring bolt 28 and in the big end of which engage the stationary expanding jaw 3 and the movable expanding jaw 4. In between the expanding jaws 3 and 4 extends the expanding wedge 55 which is connected to the piston of the piston and cylinder unit 61.

The hydraulic circuit further shows the energy storing device 60 which is connected to the safety device 62 which in a known manner comprises a shut-off valve and an overpressure valve.

Connected to the safety device 62 by a pipe 65 is the control valve 63 which for its part is connected by the pipe 66 to the piston and cylinder unit 61.

As can be seen from Fig. 5, the assembly further includes a main pump 67 with which hydraulic medium can be fed to the energy storing device 60 via the pipe 65 and the safety device 62 to build up a storage force. Also provided is a prestressing device 68 with which hydraulic medium can be fed via a directional control valve 80 via a pipe 81 to the piston and cylinder unit 61 for prestressing.

The assembly furthermore contains a directional control valve 82 with which can be controlled on the one hand the control valve 63 and on the other hand an escape valve 83 which is connected to the piston and cylinder unit 61.

The fracture separation process now goes as follows. First the energy storing device 60 is brought by the main pump 67 to its operating pressure. Following this or concurrently, the expander 5 is prestressed, i.e. hydraulic medium is fed to the piston and cylinder unit 61 via the hydraulic pump 69 of the prestressing device 68 via the directional control valve 80 and the pipes 81 and 66 up to a given pressure. Due to this prestressing, the stationary expanding jaw and the movable expanding jaw 4 abut without play against the inner surface of the big end of the connecting rod 2. The connecting rod can here be prestressed with a given high force. This force

must however be such that the material expansion resulting from the prestressing force remains within the elastic range. The result of overcoming some of the elasticity of the connecting rod material is that the fracture separation process to be carried out subsequently is accelerated.

This fracture separation process is commenced by means of the directional control valve 82.

This directional control valve 82 opens first the escape valve 83 and, after a slight delay, the control valve 63. As the control valve 63 is designed in such a way that it releases a relatively large throughflow cross-section within a very short period of time, the hydraulic medium stored in the energy storing device 60 can flow through the pipes 64, 65 and 66 suddenly into the piston and cylinder unit and thus the expanding wedge 55 can suddenly be driven in between the stationary expanding jaw 3 and the movable expanding jaw 4. As the escape valve 83 is open, no significant resistance is offered to this movement within the piston and cylinder unit 61, so that the energy released can suddenly drive the expanding wedge 55 in between the expanding jaws.

In this way the fracture separation process is so "fast" that a manner of operation which comes very close to an apparatus working with an impact mass is ensured. Therefore with apparatuses of the kind according to the invention a fracture separation result of high quality is achieved with relatively low technical elaborateness. The high-quality fracture separation result is also due to the fact that the expanding wedge 55 has a supporting effect on the two expanding jaws 3 and 4 from the inside and thus prevents bending of the two expanding jaws which are basically mounted on one side. In this way supporting elements such as clasps or the like such as are required with apparatuses according to DE-U-8 905 863 are not necessary.

Claims

1. Apparatus for the separation of connecting rods (2) by fracture
- with one stationary expanding jaw (3),
- with one movable expanding jaw (4),
- with an expander (5) in the form of an expanding wedge (55) for forcing apart the expanding jaws, and
- with an actuator (9) comprising a hydraulic piston and cylinder unit (61) for applying an expanding force to the expanding wedge,

characterised in that the actuator (9) includes an energy storing device (60) as well as a control valve (63) which is arranged between the energy storing device and the piston and cylinder unit (61) and via which hydraulic medium stored under pressure in the energy storing device can be fed suddenly to the piston and cylinder unit (61).

2. Apparatus according to claim 1, characterised in that the energy storing device (60) includes a high-pressure vessel whose interior is divided by a dividing diaphragm into two chambers, one of which is filled with hydraulic medium and the other with a compressed gas.

3. Apparatus according to claims 1 and 2, characterised in that the control valve (63) is designed as a two-way cartridge valve with which within a short period of time a relatively large throughflow cross-section can be released.

4. Apparatus according to claims 1 to 3, characterised in that between energy storing device (60) and control valve (63), as well as between control valve (63) and piston and cylinder unit (61), connecting pipes (64, 65, 66) with short dimensions and low hydraulic resistance are provided.

5. Apparatus according to claims 1 to 4, characterised in that the piston and cylinder unit (61) is fitted with an escape valve (83) with a large control cross-section.

6. Apparatus according to claim 1 or 2, characterised in that between the energy storing device (60) and the control valve (63) is provided a safety device (62).

7. Apparatus according to claim 6, characterised in that the safety device (62) has a shut-off valve and an overpressure valve.

8. Apparatus according to one or more of the preceding claims, characterised in that a prestressing device (68) is provided.

9. Apparatus according to claim 8, characterised in that the prestressing device (68) includes a separate hydraulic circuit with which hydraulic medium can be fed directly to the piston and cylinder unit (61).

10. Apparatus according to claim 9, characterised in that the separate hydraulic circuit is fitted with its own hydraulic pump (69).

11. Apparatus according to claim 1, characterised in that the stationary expanding jaw (3) is mounted on a stationary apparatus base (71) which carries the supporting elements for the cap.

12. Apparatus according to claim 11, characterised in that the movable expanding jaw (4) is arranged on a straight-line mechanism (72).

13. Apparatus according to claim 12, characterised in that the supporting elements for the cap are arranged on the straight-line mechanism.

Fig. 1

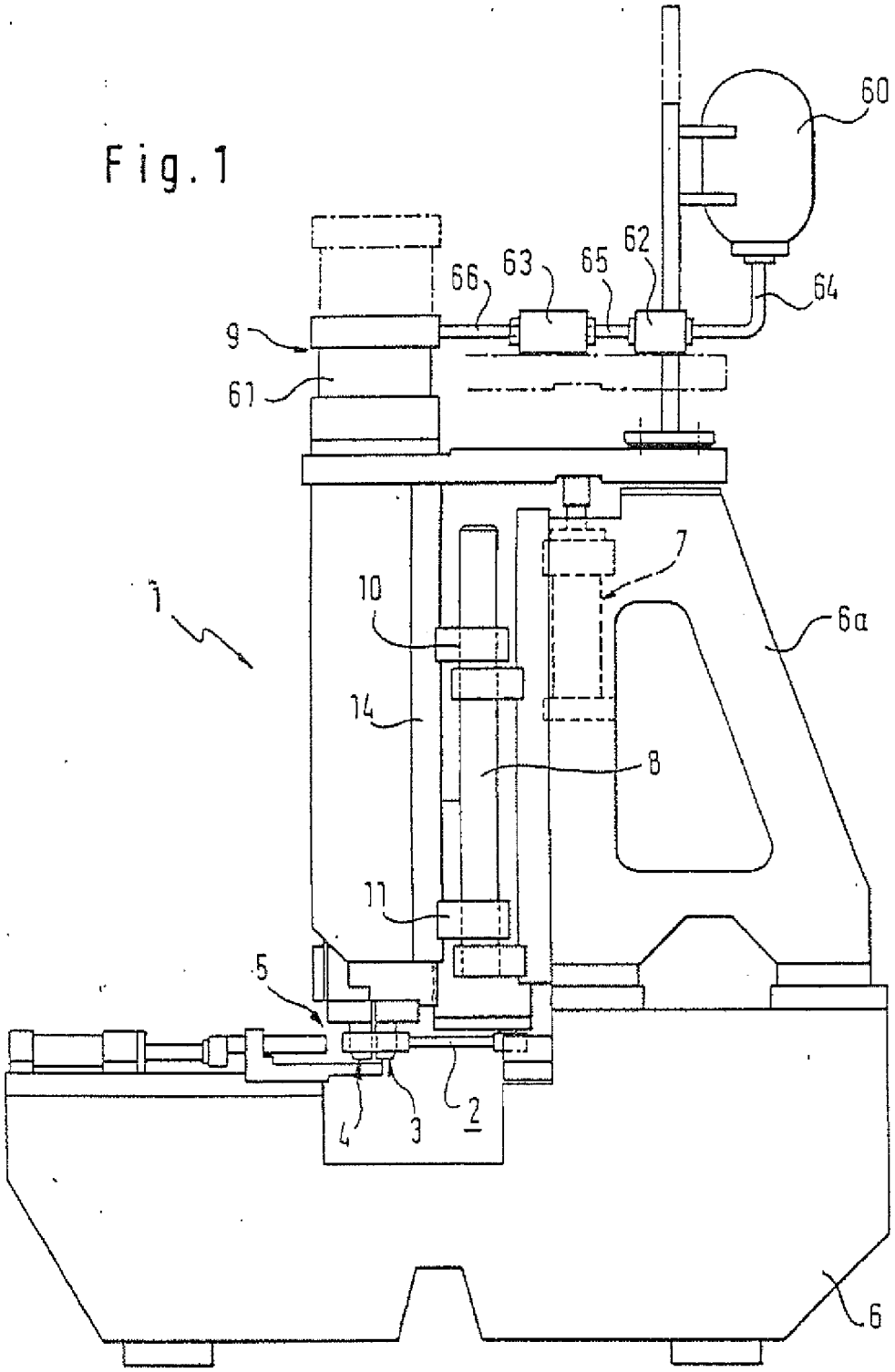

Fig. 2

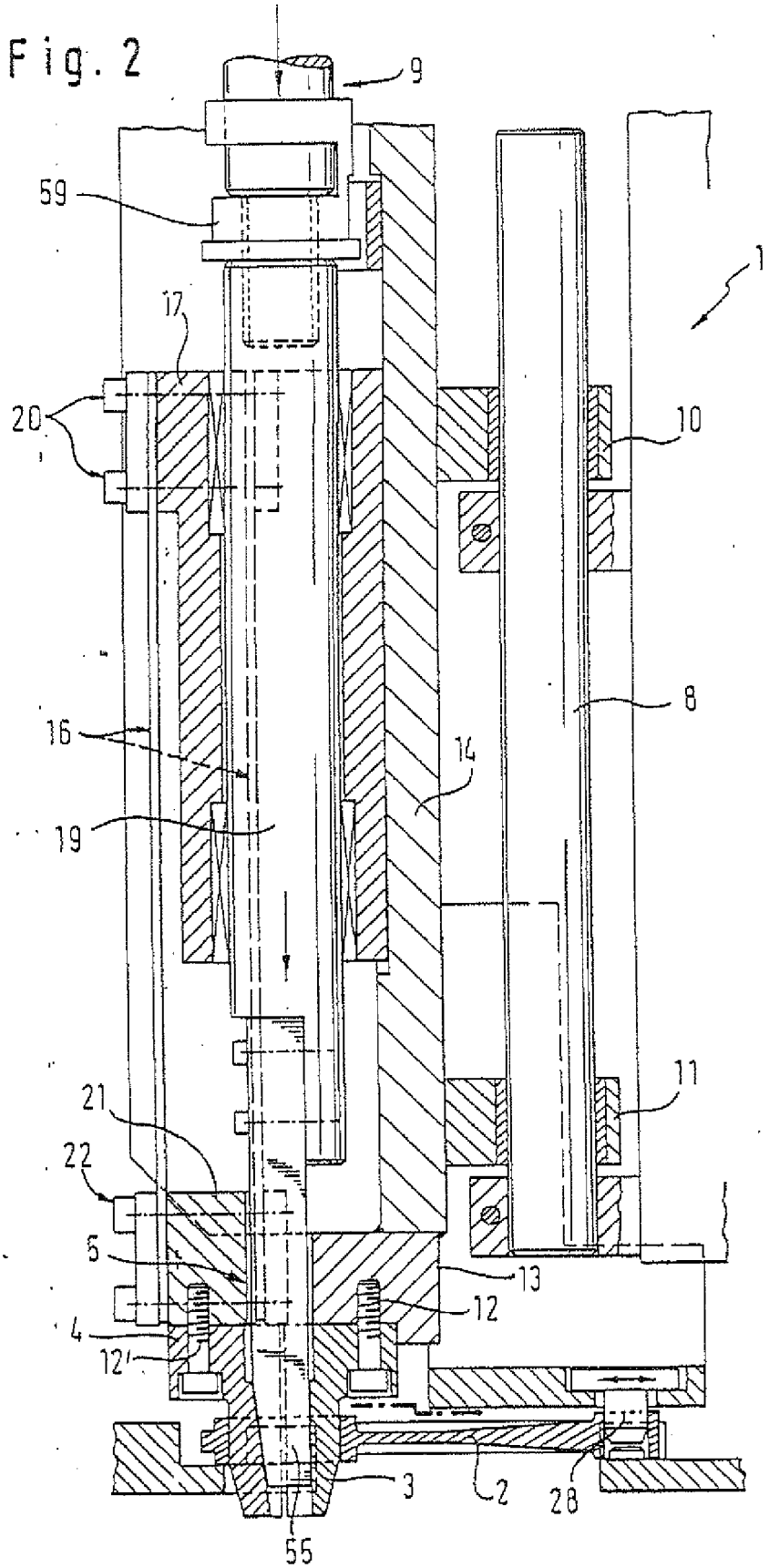

Fig. 4

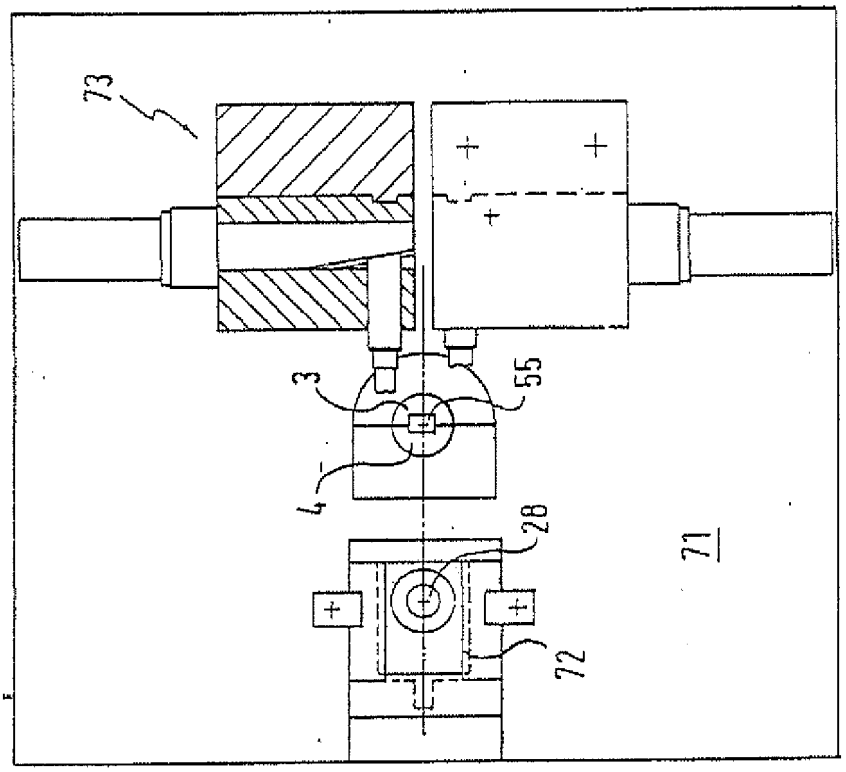


Fig. 3

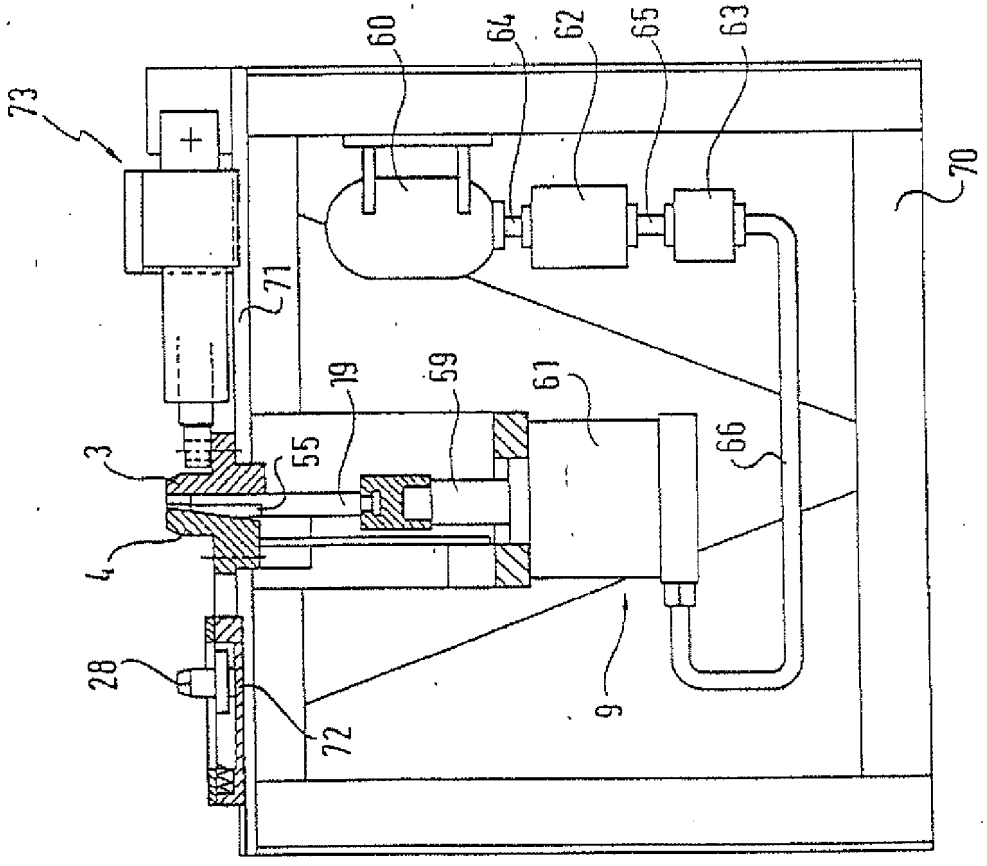

Fig. 5